Response to reviews

Dear Editor:

We have revised our manuscript, "Tree height and leaf drought tolerance traits shape growth responses across droughts in a temperate broadleaf forest" (previously "Tree height and hydraulic traits shape growth responses across droughts in a temperate broadleaf forest"), according to the recommendations of reviewers.

...

We hope that this manuscript will now be found suitable for publication in *New Phytologist*, and we look forward to your response.

Best regards,

Kristina Anderson-Teixeira (on behalf of all authors)

Decision: Accept subject to revision

Referee: 1

Comments to the Author

The authors have done a thorough job of addressing my concerns and I found the revised manuscript much improved. Well done!

Thank you.

Referee: 2

Comments to the Author

Thank you very much for sending me this revised version of the ms by McGregor et al. It is a very important study with a clever and appropriate sampling design, and is exceptionally well written. I enjoyed reading it again and find it very valuable. Thanks very much to the authors for tweaking the text here and there and adding detail, which made the ms even more compelling. I had a few reactions that might be useful:

72 One suggestion is that it would be better not to say that larger individuals have xylem of "greater efficiency." Instead, Red Queen like, conduits widen allowing whole-pathlength resistance to remain constant over much of the height range of trees. Presumably selection favors variants in which leaves maintain their productivity constant insofar as is possible as an individual grows taller, and resistance as constant as possible would contribute to this. So, taller trees don't have more efficient conduits; they widen in a way that maintains the same whole-pathlength efficiency. Here you could say something like "taller trees have wider conduits, which help maintain constant the resistance that would otherwise increase as trees grow taller."

We have reworded the sentence to read, "Taller trees have wider conduits in the basal portions of taller trees, both within and across species (Olson *et al.*, 2018; Liu *et al.*, 2019) and throughout the conductive systems of angiosperms (Zach *et al.*, 2010; Olson *et al.*, 2014, 2018), which help maintain constant the resistance that would otherwise increase as trees grow taller."

392 "Constraint" is always such a vague term in biology (meaning everything from factors opposing selection to selection itself), with every biologist understanding something different. Replacing the term always seems to me to lead to increased clarity. Here, it could be removed entirely "previous findings that it is impossible for trees. . . ", I think profitably.

We have made this change. It now reads, "Mechanistically, this is consistent with, and reinforces, previous findings that it impossible for trees to efficiently transport water to great heights and simultaneously maintain strong resistance and resilience to drought-induced embolism (Couvreur *et al.*, 2018; Roskilly *et al.*, 2019; Olson *et al.*, 2018)."

395 if taller individuals are exposed to greater evaporative demand, then for a given photosynthetic productivity they would require greater conductance than they would need for a given height if they were sheltered. This would favor even wider conduits, making taller individuals even more vulnerable! You rightly highlight the need to separate height per se and canopy position.

Yes, we agree. Thank you.

With regard to root mass, this might be useful: https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdoi.org%2F10.1371%2Fjournal.pone.0086550&data=02%7C01%7CTeixeiraK%40si.edu%7C04ca4a8deb534237b5a508d84dd84e13%7C989b5e2a14e44efe93b78cdd5fc5d11c%7C0%7C0%7C637344938706540440&sdata=tiYufg0%2F%2BuRBThcGeUHuRjVDhWPmbK0xP%2Fb2moH%2F210%3D&reserved=0 seem to show above-below ground biomass isometry.

Thank you. We have added this reference in two places (intro and discussion).

Thanks again and congratulations to the authors.

Thank you.

Mark Olson

Referee: 3

Comments to the Author

This is a resubmission of a previously revised manuscript. I have enjoyed reading the manuscript. The paper is well written and the methods are clearly presented. The hypotheses are sound and well framed within the physiological implications of tree height.

The authors have satisfactorily answered most previous comments. For instance, I appreciated the discussion on the two indices Rt and Rtarima. I agree that results comparing them are pretty similar (Table S6 vs Table S7) and that authors can use Rt.

Yet, I still believe there are a couple of details that need revision:

1) I still think that adding the same analysis on the two other resilience indices (resilience and recovery) from Lloret et al. (2011) would increase the interest of the manuscript (as the authors acknowledge in line 476). Using DeSoto et al. 2020 as a justification is not enough. There are potential caveats in that paper and even if we accepted the general trends in growth resilience proposed in that study, studies like that of McGregor et al. apply at a different and more detailed scale, where those global relationships might not hold. This adds interest to the present ms, but for that same reason most readers will like to see a similar discussion on the other complementary growth resilience indices together in the same paper.
2) In Line 263 it is stated that both marginal and conditional R2 are reported, but then I could only find conditional R2s in Table S6, S7. Please, report also marginal R2 in those Tables to show how much variability it is explained by the fixed effects (i.e. the traits and independent variables in Table 3). This is important so we can judge how robust the tested covariates are. I can accept what authors argue in their response ('Tree-ring data are inherently noisy, particularly in more mesic forests. In large part, this is due to strong neighborhood effects, along with variable allocation to ring growth around the circumference of the tree. These factors contribute to the low R2, but do not negate the significance of our findings'). However, still I think that, even if (or particularly because) we see many papers today with very low variability explained (see for instance some of the analyses in the previously mentioned DeSoto et al. 2020), we should demand a minimum level of explanatory power in models in ecophysiological papers. Otherwise we cannot assure that inferences are robust enough and relationships worth to be discussed.

Other comments:

- As mentioned on a previous comment, in the manuscript the authors sampled dead and live trees, but then I did not see any further mentioning to this later in the manuscript (lines 175-178 and Table 2). This would merit some discussion and further analysis, how many trees were died and how many trees were alive of those in Table 2?
- Figure S4 and line 333: are differences expressed by different letters correct in Figure S4? Particularly for π_{tlp} (S4d) the boxplot suggests differences (more than, e.g. in b) among different species but then letters are similar (as discussed in line 333).
- LMA is not shown in Figure S4, and in Table 2 there are no tests so we cannot judge whether there are differences among species for that leaf trait. Please, add also LMA to Figure S4.
- Line 135: leave turgor 'at' lower ....
- Line 272: please define dAIC. I think it should be better and more robust to stick in all cases to dAIC>2, there are only two covariates selected with <1 in Table S4.
- Line 312: please, refer to the corresponding Table or Supplement where this statement is supported.
- Line 371-372: actually it is radial growth that is affected; whether that can be extrapolated to the tree level is something that needs to be demonstrated.

- Line 385 vs lines 308-309 and line 338: does that mean that there was a correlation between canopy position and positive Rt? Can it also be related to moisture sensitivity of different species, or to niche (microenvironment) partitioning among species? (as nicely discussed in lines 420-422). I see from lines 445-450 that sampled FAGR were small, which is coherent with the authors' statement.

Table S5: no need to specify dAIC>1.

Citations

Couvreur V, Ledder G, Manzoni S, Way DA, Muller EB, Russo SE. **2018**. Water transport through tall trees: A vertically explicit, analytical model of xylem hydraulic conductance in stems. *Plant, Cell & Environment* **41**: 1821–1839.

Liu H, Gleason SM, Hao G, Hua L, He P, Goldstein G, Ye Q. **2019**. Hydraulic traits are coordinated with maximum plant height at the global scale. *Science Advances* **5**: eaav1332.

Olson ME, Anfodillo T, Rosell JA, Petit G, Crivellaro A, Isnard S, León-Gómez C, Alvarado-Cárdenas LO, Castorena M. **2014**. Universal hydraulics of the flowering plants: Vessel diameter scales with stem length across angiosperm lineages, habits and climates. *Ecology Letters* **17**: 988–997.

Olson ME, Soriano D, Rosell JA, Anfodillo T, Donoghue MJ, Edwards EJ, León-Gómez C, Dawson T, Martínez JJC, Castorena M ***et al.*** **2018**. Plant height and hydraulic vulnerability to drought and cold. *Proceedings of the National Academy of Sciences* **115**: 7551–7556.

Roskilly B, Keeling E, Hood S, Giuggiola A, Sala A. **2019**. Conflicting functional effects of xylem pit structure relate to the growth-longevity trade-off in a conifer species. *PNAS. doi: /10.1073/pnas.1900734116.*

Zach A, Schuldt B, Brix S, Horna V, Culmsee H, Leuschner C. **2010**. Vessel diameter and xylem hydraulic conductivity increase with tree height in tropical rainforest trees in Sulawesi, Indonesia. *Flora - Morphology, Distribution, Functional Ecology of Plants* **205**: 506–512.